Radioactivity in the Risø District January-June 2012

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DTU Nutech Report

Sven P. Nielsen, Kasper G. Andersson and Arne Miller
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December 2012

DTU Nutech
Center for Nuclear Technologies

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Title: Radioactivity in the Risø District January-June 2012
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Abstract (max. 2000 char.): The environmental surveillance of the Risø environment was continued in January-June 2012. The mean concentrations in air were: 0.48±0.38 μBq m^{-3} of ^{137}Cs, 3.69±1.79 mBq m^{-3} of ^{7}Be and 0.21±0.20 mBq m^{-3} of ^{210}Pb (±1 S.D.; N = 26). The depositions by precipitation at Risø in the first half of 2011 were: 0.052 Bq m^{-2} of ^{137}Cs, 420 Bq m^{-2} of ^{7}Be, 21.5 Bq m^{-2} of ^{210}Pb and < 0.5 kBq m^{-2} of ^{3}H. The average background dose rate (TLD) at Risø (Zone I) was 99 nSv h^{-1} compared with 89 ± 9 nSv h^{-1} (±1 S.D.; N = 4) in the four zones around Risø.

TLD results for the period November 2011 – April 2012 are significantly higher than results for the periods before and after this one. Raw data and calculations have been checked without finding a reason why these results show larger doses. The results are close to the detection limit for these dosimeters and the higher results could be due to measurement uncertainties, but measurement errors cannot be excluded.

The increased background dose rates measured with TLD's are believed to be due to unidentified technical reasons. Increased levels in external gamma radiation at the Risø zones during November 2011 to April 2012 were neither identified from measurements of terrestrial dose rates with a NaI(Tl) detector nor from the permanent monitoring station at Risø operated by the Danish Emergency Management Agency.

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Contents

Table 1. Radionuclides in ground level air collected at Risø (cf. Figs. 1, 1.1 and 1.2), January - June 2012. (Unit: μBq m^{-3})

Date		^{7}Be	^{137}Cs	^{210}Pb
02-Jan-12 –	09-Jan-12	932	0.139	32
09-Jan-12 –	16-Jan-12	1650	0.291	56
16-Jan-12 –	23-Jan-12	1484	0.240	59
23-Jan-12 –	30-Jan-12	3437	1.423	794
30-Jan-12 –	06-Feb-12	4931	1.272	723
06-Feb-12 –	13-Feb-12	2966	1.117	425
13-Feb-12 –	20-Feb-12	3406	0.475	90
20-Feb-12 –	27-Feb-12	2426	0.268	55
27-Feb-12 –	05-Mar-12	2255	0.441	121
05-Mar-12 –	12-Mar-12	3203	0.258	129
12-Mar-12 –	19-Mar-12	3151	0.340	160
19-Mar-12 –	26-Mar-12	2736	0.508	156
26-Mar-12 –	02-Apr-12	4233	0.737	238
02-Apr-12 –	10-Apr-12	3752	0.317	148
10-Apr-12 –	16-Apr-12	2450	0.378	119
16-Apr-12 –	23-Apr-12	3474	0.341	145
23-Apr-12 –	30-Apr-12	6821	0.431	230
30-Apr-12 –	07-May-12	7500	0.598	291
07-May-12 –	11-May-12	3855	0.304	194
11-May-12 –	21-May-12	2960	0.329	119
21-May-12 –	29-May-12	8828	1.300	542
29-May-12 –	04-Jun-12	2789	0.134	58
04-Jun-12 –	11-Jun-12	4226	0.275	135
11-Jun-12 –	18-Jun-12	3412	0.156	154
18-Jun-12 –	25-Jun-12	4862	0.152	142
25-Jun-12 –	02-Jul-11	4205	0.152	148
Mean		3690	0.476	210
SD		1788	0.379	197

Table 2.1. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2012. (Unit: Bq m^{-3})

Month	^{7}Be	^{137}Cs	^{210}Pb
January	779	0.038	20
February	1765	0.219	170
March	1737	0.518	94
April	2865	0.347	131
May	3367	1.025	262
June	2155	0.147	101

Table 2.2. Radionuclides in precipitation in the 10 m^2 rain collector at Risø (cf. Fig. 1), January - June 2012. (Unit: Bq m^{-2})

Month	Precipitation (m)	^{7}Be	^{137}Cs	^{210}Pb
January	0.055	43.2	0.0021	1.1
February	0.012	21.0	0.0026	2.0
March	0.014	24.1	0.0072	1.3
April	0.034	96.0	0.0125	4.4
May	0.015	49.5	0.0151	3.9
June	0.086	186.4	0.0127	8.8
Sum	0.216	420.2	0.0522	21.5

Table 2.3. Tritium in precipitation collected at Risø (cf. Figs. 1, 2.3.1 and 2.3.2). January - June 2012. (Unit: kBq m^{-3})

Month	1 m^2 rain collector*	10 m^2 rain collector*
January	< 1.7 *	1.8
February	< 1.7 *	3.0
March	2.2 *	< 1.7
April	< 1.7 *	3.5
May	< 1.7 *	2.3
June	< 1.7 *	< 1.7

Double determinations*.

Table 2.4. Tritium in precipitation collected at Risø (cf. Fig. 1). January - June 2012. (Unit: kBq m^{-2})

Month	Precipitation (m)	1 m^2 rain collector	10 m^2 rain collector
January	0.055	< 0.094	0.099
February	0.012	< 0.020	0.036
March	0.014	0.031	< 0.024
April	0.034	< 0.058	0.119
May	0.015	< 0.026	0.035
June	0.086	< 0.146	< 0.146
Sum	0.216	< 0.374	< 0.459

Table 3.1. Radionuclides in sediment samples collected at Bolund in Roskilde Fjord.(cf. Fig. 3.1) January - June 2012. (Unit: Bq kg^{-1} dry)

No samples in this period.

Table 4.1. Radionuclides in seawater collected in Roskilde Fjord (cf. Fig. 4.1) January - June 2012. (Unit: Bq m^{-3})

No samples in this period.

Table 4.2. Tritium in seawater collected in Roskilde Fjord (Risø pier) (cf. Fig. 4.2) January - June 2012.

Month	kBq m^{-3}
January	< 1.7 *
February	< 1.7 *
March	2.0 *
April	1.9 *
May	2.6 *
June	1.9 *

* Double determinations

Table 5.1. Radionuclides in grass (snow) collected at Risø (near the Waste Treatment Station (cf. Fig. 1)), January - June 2012. (**Measured on bulked ash samples)*

Week no. or month	Date	K (g kg^{-1} fresh)	^{137}Cs (Bq kg^{-1} fresh)	^{137}Cs (Bq m^{-2})
1	2 January	2.1	<0.3	
3	16 January	3.1	<0.5	
5	30 January*	<0.1	<0.3	
7	13 February*	<0.1	<0.3	
9	27 February	2.6	<0.4	
11	12 March	2.4	<0.5	
13	26 March	5.3	<1.3	
15	10 April	2.7	<0.4	
17	23 April	2.7	<0.3	
19	7 May	5.3	<0.4	
21	21 May	6.9	<0.5	
23	4 June	5.3	<0.6	
25	18 June	5.2	<0.4	
**January			0.070	0.032
**February			<0.044	< 0.017
**March			0.174	0.035
**April			<0.027	< 0.013
**May			<0.050	< 0.014
**June			0.082	0.026

Table 5.2. Radionuclides in Fucus vesiculosus collected at Bolund in Roskilde Fjord. January - June 2012. (Unit: Bq kg^{-1} dry)

No samples in this period.

Table 7.1. Waste water collected at Risø (cf. Fig. 1), January - June 2012.

Week number	eqv. mg KCl l^{-1}	^{137}Cs (Bq m^{-3})	^{131}I (Bq m^{-3})	^{226}Ra (Bq m^{-3})
1	94	<109	<114	<213
2	32	<108	<117	<218
3	74	<101	<108	<222
4	73	<111	<116	<222
5	195	<103	<110	<223
6	107	<101	<106	<202
7	79	<109	<106	<214
8	184	<51	<58	<105
9	200	<106	<105	<200
10	176	<102	<101	<193
11	200	<103	<111	<218
12	135	<108	<116	<230
13	138	<113	<117	<212
14	179	<119	<116	417
15	180	<106	<107	<199
16	192	<113	<115	<210
17	162	<102	<106	<191
18	160	<78	<89	<159
19	128	<107	<110	<206
20	124	<68	<67	<145
21	125	<108	<118	<219
22	126	<106	<112	<208
23	119	<97	<108	<196
24	116	<109	<112	<224
25	118	<106	<108	<200
26	93	<110	<108	444
Mean	135.0			
SD	45.4			

Table 8.1. Background dose rates around the border of Risø (cf. Fig. 8.1) measured with thermoluminescence dosimeters (TLD) in the period November 2011 – April 2012. (Results are normalized to nSv h^{-1})

Location	nSv h^{-1}
1	91
2	82
3	85
4	86
5	92
6	95
Mean	89

Note regarding Table 8.1 and 8.2

TLD results for the period November 2011 – April 2012 are significantly higher than results for the periods before and after this one. Raw data and calculations have been checked without finding a reason why these results show larger doses. The results are close to the detection limit for these dosimeters and the higher results could be due to measurement uncertainties, but measurement errors cannot be excluded.

The increased background dose rates measured with TLD's are believed to be due to unidentified technical reasons. Increased levels in external gamma radiation at the Risø zones during November 2011 to April 2012 were neither identified from measurements of terrestrial dose rates with a NaI(Tl) detector (Table 8.3) nor from the permanent monitoring station at Risø operated by the Danish Emergency Management Agency.

Table 8.2. Background dose rates around Risø (cf. Fig. 8.2 and Fig. 1) measured with thermoluminescence dosimeters (TLD) in the period November 2011 – April 2012. (Results are normalized to nSv h^{-1}),

Risø zone	Location	nSv h^{-1}
I	1	75
I	2	88
I	3	119
I	4	115
I	5	97
Mean		99
II	P1	89
II	P2	87
II	P3	69
II	P4	101
Mean		87
III	P1	87
III	P2	90
III	P3	85
Mean		87
IV	P1	83
IV	P2	80
IV	P3	92
IV	P4	93
IV	P5	91
IV	P6	83
IV	P7	100
Mean		89
V	P1	99
V	P2	91
V	P3	103
V	P4	78
V	P5	99
V	P6	75
V	P7	79
V	P8	95
V	P9	91
V	P10	100
Mean		91

*Table 8.3. Terrestrial dose rates at the Risø zones (cf. Fig. 8.2 and Fig. 1) January - June 2012. Measured with a NaI(Tl) detector. (Unit: nSv h^{-1})**

Risø zone	Location	January
I	P1	30
I	P2	37
I	P3	305
I	P4	33
I	P5	47
Mean		90
II	P1	33
II	P2	32
II	P3	31
II	P4	32
Mean		32

*Starting 2012, levels in Risø zones I and II are reported biannually, and levels in zones III, IV and V are reported annually (measurements in autumn).

Fig. 1. Locations for measurements of gamma-background radiation Zone I and II (cf. Tables 8.2 and 8.3)

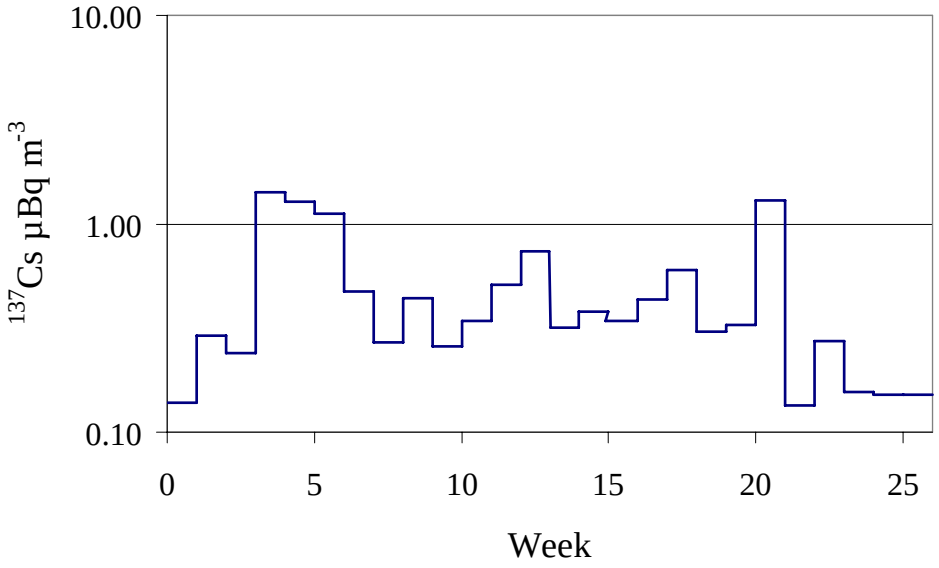

Fig. 1.1. Caesium-137 in ground level air collected at Risø in January-June 2012. (Unit: µBq m^{-3})

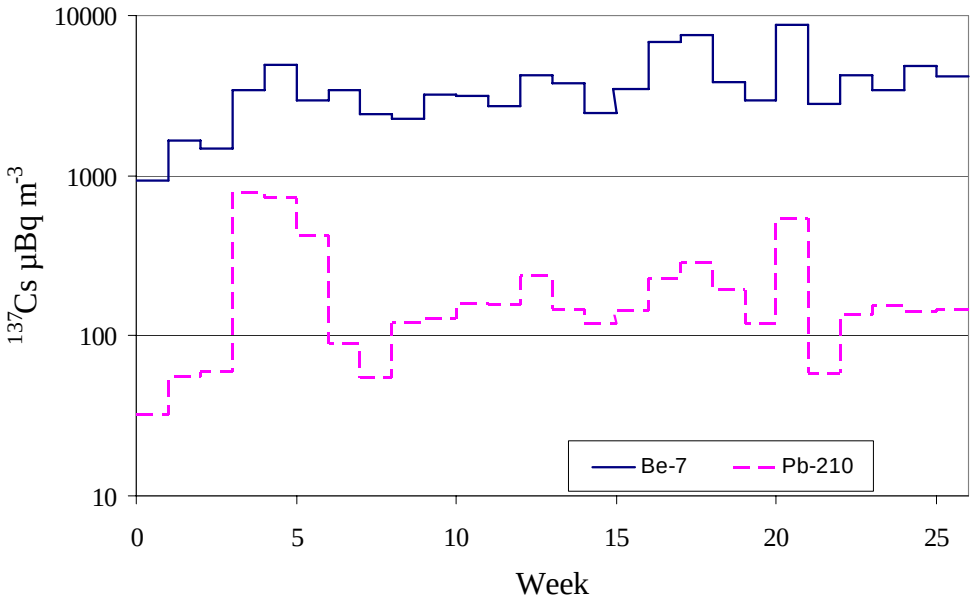

Fig. 1.2. Beryllium-7 and Lead-210 in ground level air collected at Risø in January-June 2012. (Unit: µBq m^{-3})

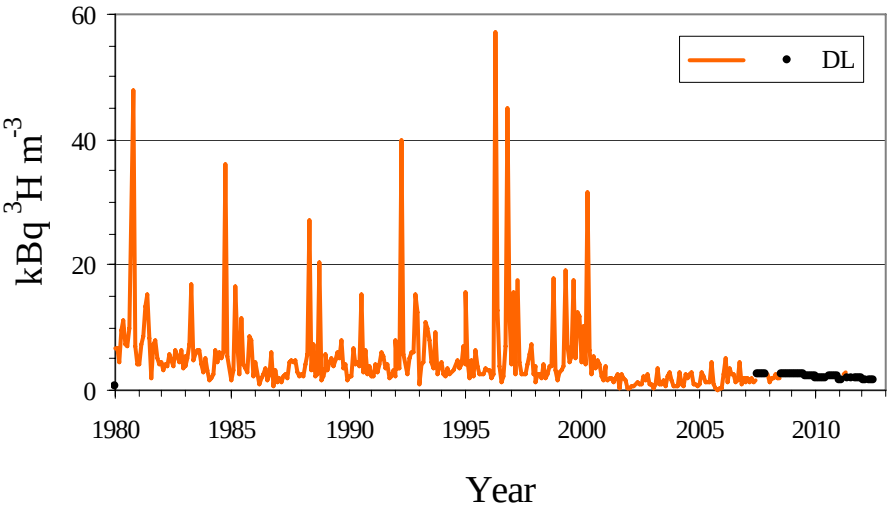

Fig. 2.3.1. Tritium in precipitation collected at Risø (1 m^2 rain collector) 1980 - 2012. (Unit: kBq m^{-3}; DL = detection limit)

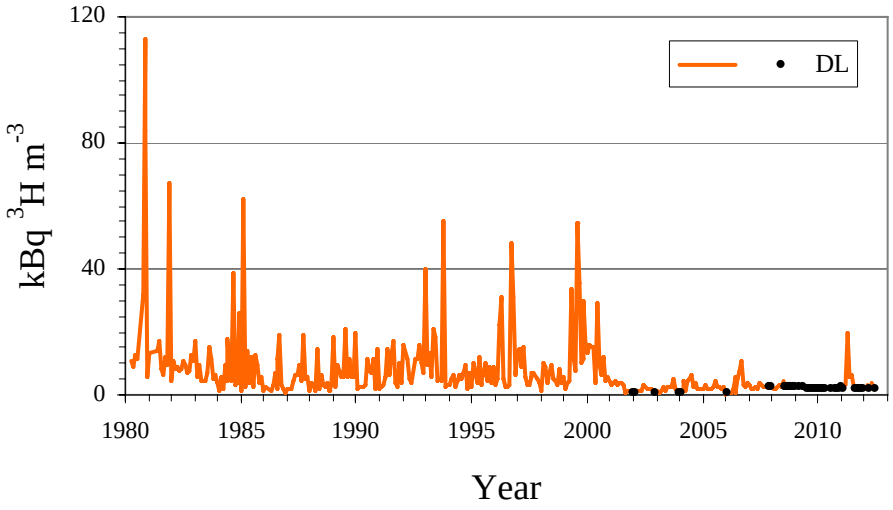

Fig. 2.3.2. Tritium in precipitation collected at Risø (10 m^2 rain collector) 1980 - 2012. (Unit: kBq m^{-3}; DL = detection limit)

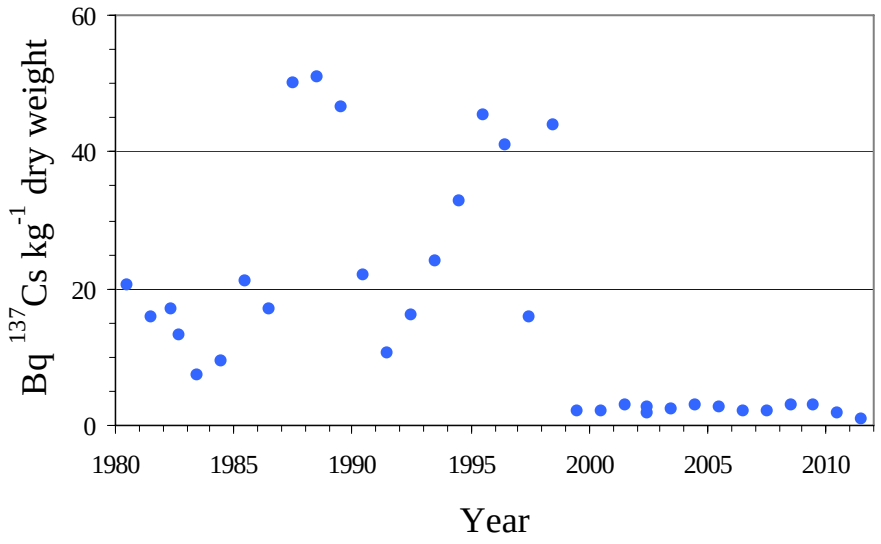

Fig. 3.1. Caesium–137 in sediment samples collected at Bolund in Roskilde Fjord. 1980 – 2012. (Unit: Bq kg^{-1} dry matter)

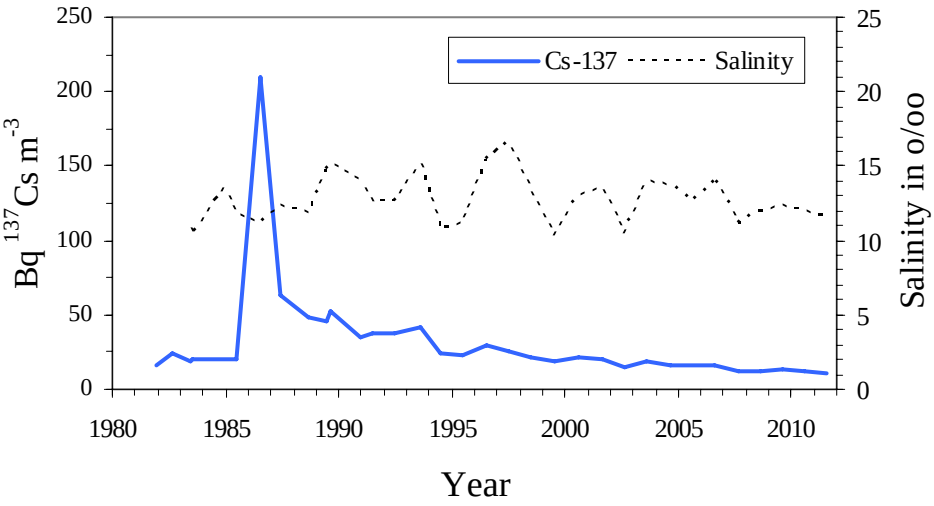

Fig. 4.1. Caesium–137 in seawater collected in Roskilde Fjord 1980 - 2012. (Unit: Bq m^{-3})

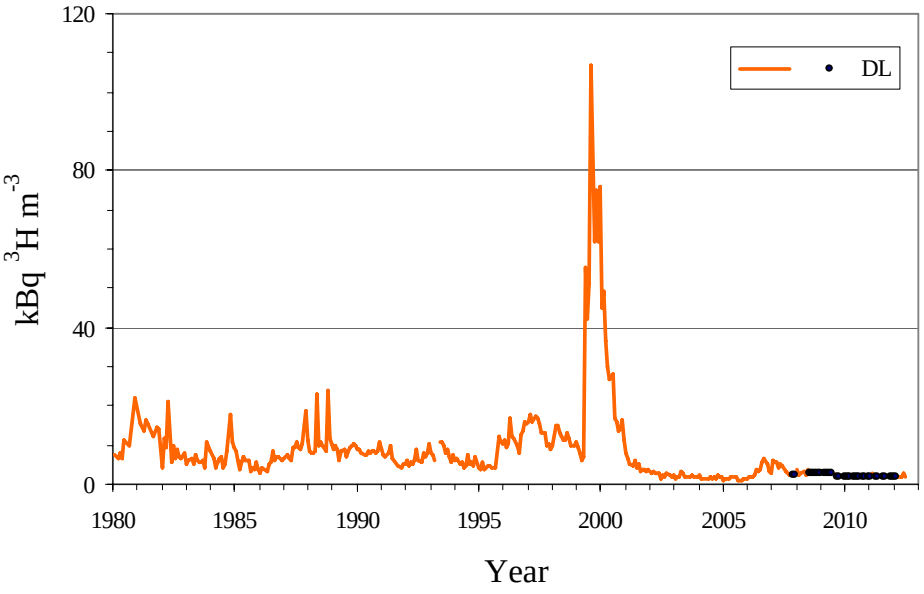

Fig. 4.2. Tritium in seawater collected in Roskilde Fjord 1980 - 2012. (Unit: kBq m^{-3}; DL = detection limit)

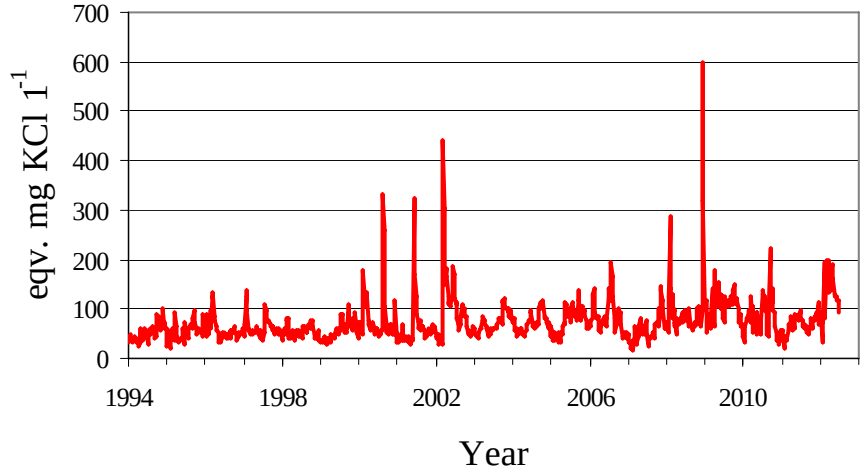

Fig. 7.1. Total-beta radioactivity in waste water collected at Risø 1994 - 2012. (Unit: eqv. mg KCl l^{-1})

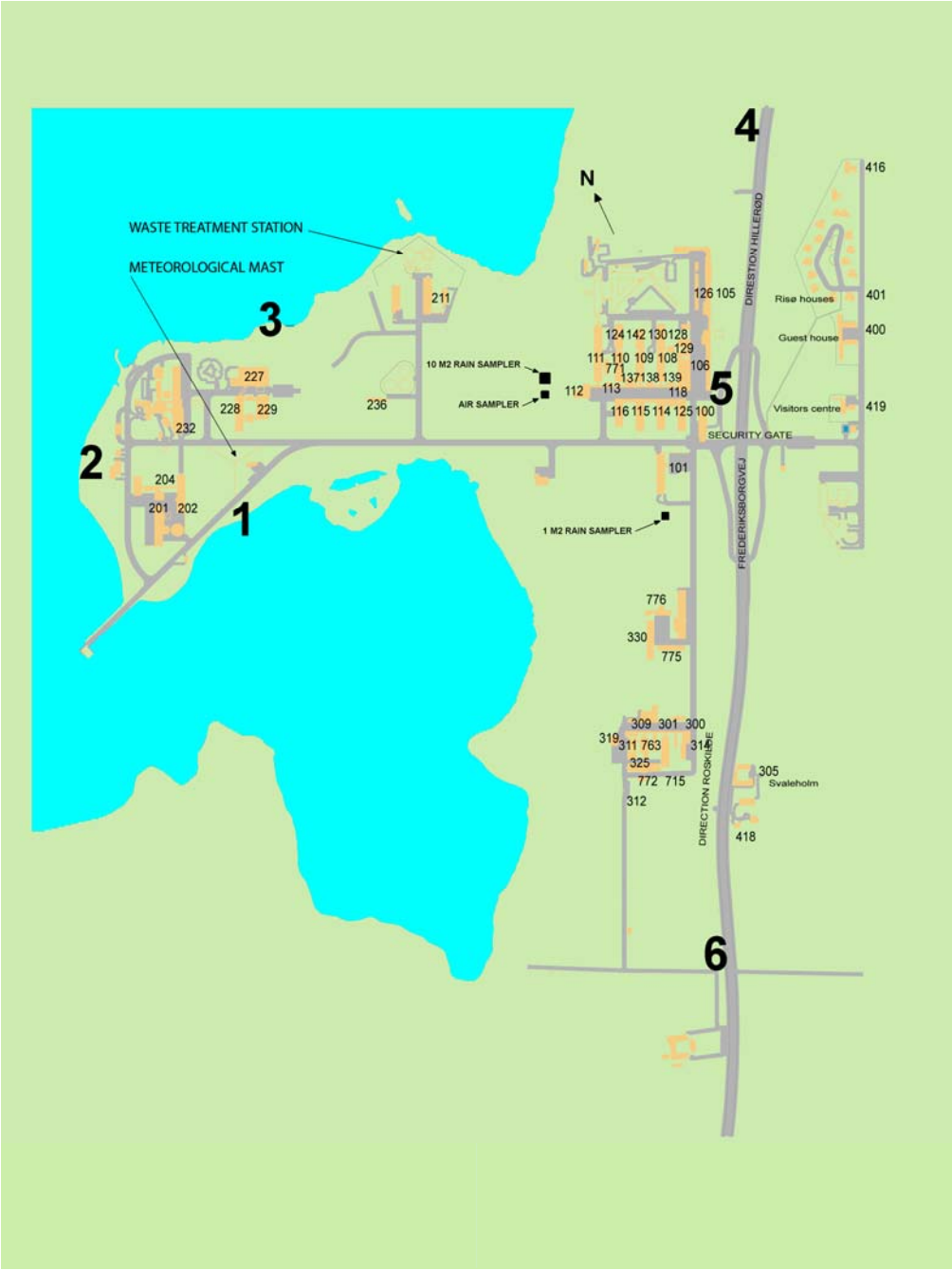

Fig. 8.1. Locations (1-6) for TLD measurements around the border of Risø (cf. Table 8.1).

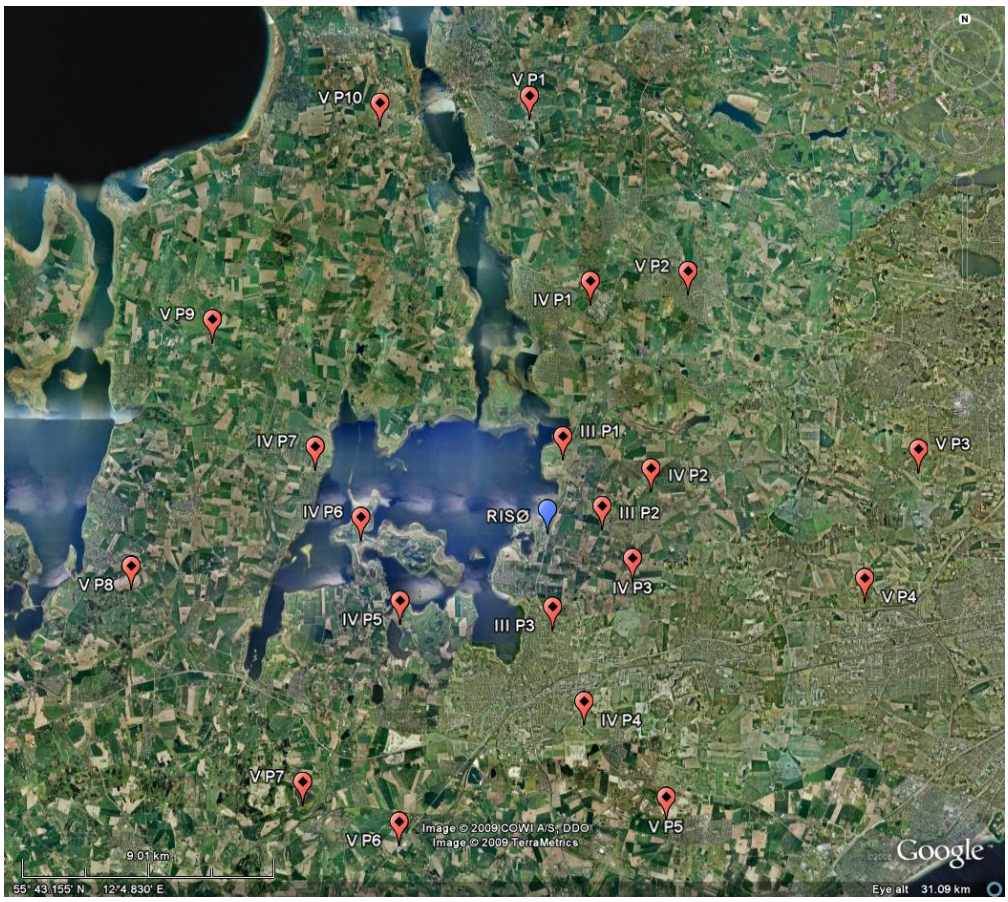

Fig. 8.2. Locations for measurements of background radiation around Risø in Zones III, IV and V.

Center for Nuclear Technologies is Denmark's national competency center for nuclear technology. With roots in research in the peaceful use of nuclear power, DTU Nutech works with the applications of ionizing radiation and radioactive substances for the benefit of society.

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